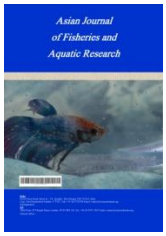

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Growth of Goramy (*Osphronemus goramy* Lac 1801) Monoculture and Polyculture with Nilem (*Osteochilus hasselti* C.V)

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Authors' contributions

This work was carried out in collaboration among all authors. Author EJD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AY and HH managed the analyses of the study. Author IB managed the literature searches. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

This research was conducted to determine the optimal density of gorami (*Osphronemus goramy* Lac 1801) and nilem (*Osteochilus hasselti* C.V) polyculture with varios nilem density. The research are carried out in the maintenance pool of the Kawungsari Fish Farmers Group, Kertayasa Village, Pangandaran Regency, Indonesia. The research method used is an experimental method with 4 treatments and 4 replications using Completely Randomized Design (CRD). Variation of stocking densities carried out with the ratio of gorami: nilem is 30 : 0 fish m^2 -1 (control), 30:10 fish m2 -1, 30: 20 fish m2 -1 and 30: 30 fish m2 -1. The fish are kept for 40 days in a pond with an area of 6 x 8 m and a height of 1.2 m. The fish used are gorami with 6-8 cm long and nilem with 4-6 cm long, gorami fish from the PangandaranKertayasa farmer group and nilem fish come from the seed hall which triggers gorami stock and nilem (BPPSIGN) Tasikmalaya. Obtained data are done at the beginning of the study and every 10 days, namely on day 10^{th}, 20^{th}, 30^{th} and 40^{th}. The parameters observed included daily growth rate, survival rate, feed efficiency, periphyton abundance and water quality. The results showed the stocking density of 30 fish m^2 -1gorami with 20 fish m^2 -1nilem was

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the most optimal stocking density with survival rate of 93.5%, daily growth rate of 1.19%, and gorami's feed efficiency is 32.66%. Pond water quality including temperature, pH and dissolved oxygen is still within optimum range in accordance with the Indonesian National Standard for maintenance of gorami and nilem.

Keywords: Monoculture; polyculture; Osphronemus goramy; Osteochilus hasselti.

1. INTRODUCTION

Gorami is a freshwater consumption fish that is easy to maintain because gorami can survive in ponds that have low oxygen, the selling price of gorami is higher than other freshwater consumption fish, because gorami has a delicious and savory taste [1]. Every Every year, the land for fish cultivation is getting narrower, especially in Java Island, Indonesia, while the demand for fish increases. With the decline in cultivated land, it requires polyculture engineering for gorami cultivation.

Polyculture is one of the aquaculture manipulation of fish cultivation by maintaining more than one fish species in the same place. Cultivation activities optimize production yields through a polyculture cultivation system [2]. Nilem fish feeds on periphyton dissolved attached to the substrate. Periphyton is a complex mixture of algae, cyanobacteria, heterotrophic microbes and detritus that is attacjed to sumerged surfaces in most aquatic ecosystem. The advantages of this nilem can be used to clean walls or nets from attached periphyton [3]. Research was conducted to determine the optimal density of gorami (*Osphronemus goramy* LAC 1801) and nilem (Osteochilus hasselti C.V) with varios nilem density.

2. MATERIALS AND METHODS

This research was carried out at Kertayasa Village, from July to October 2019. Freshwater cages of 1m x 1m x 1m and pnds of 6m x 8m 1.2m were use for fish cultivation. Water qualitu parameters and fish measurements were carried out with DO meter (Lutron brand) pH meter (Lutron Brand) and digital scales (sf 400). A total of apparently healthy 480 gorami individuals (6-8 cm in length) and apprently healthy 240 nilem individuals (4-6 in length) were used in the research study which were fed with a commercial fish feed (PF 500) within protein content (39-41%), fat (5%), fiber (4%), ash (14%), and maximum water content (10%). Gorami fingerlings were obtained from Kertayasa Village and nilem fishes were obtained from Hatchery for Gorami and Nilem Fish Stock Support (BPPSIGN) Tasikmalaya, West Java. The fish used must have a homogeneous.

The experimental design carried out in this research was a Completely Randomized Design (CRD) consisting of four treatments and four replications, namely:

Treatment A : 30 *Osphronemus goramy*
Treatment B : 30 *Osphronemus goramy* : 10 *Osteochillus hasselti*
Treatment C : 30 *Osphronemus goramy* : 20 *Osteochillus hasselti*
Treatment D : 30 *Osphronemus goramy* : 30 *Osteochillus hasselti*

Floating net cages are installed in ponds and left for 7 days for the perifiton to grow, after which fish are put into floating net cages. fish are fed 2 times a day at 08.00 and 16.00 with 5% content of gorami biomass. fish and water quality were measured on the first day and every 10 days until the 40th day. The research lasted for 40 days. Parameters observed during the research included survival rate, specific growth rate, feedingefficieny, abundance of periphyton and water quality. The data obtained were then analyzed using analysis of F test variance with 95% confidence level.

2.1 Survival Rate

Survival rate was calculated using the formula according to [4]:

$$Sr = \frac{Nt}{No} \times 100\%$$

Note : Sr : Survival Rate (%) Nt : Number of fish at the end No: Number of fish at the beginning

2.2 Specific Growth Rate

SGR (*specific growth rate*) according to [5]:

$$SGR = \frac{\ln Wt - \ln W_0}{t} \times 100\ \%$$

Note : SGR : Specific Growth Rate (%/day) Wo: Weight of fish at the beginning (g) Wt : Weight of fish at the end (g) t : Observation time (40 days)

2.3 Feeding Efficieny

Feeding efficieny according to [6]:

$$FE = \frac{(Wt+D)-Wo}{F} \times 100\%$$

Note : FE : Feeding efficieny (%) Wt: The weight of biomass at the end (g) Wo : The weight of biomass at the beginning (g) D : dead weight of fish (g) F : Number of food given (g)

2.4 Periphyton Abudance

Periphyton observations were carried out on the 20th day, taking samples of periphyton from net. Periphyton abundance was calculated using the Inverted Microscope Method Counts [7]:

$$N = n \times \frac{A}{B} \times \frac{C}{D} \times \frac{1}{E}$$

Note : N : Abundance periphyton (ind/cm^2) A: Cover glass area (484 mm) B: Field of view (3 x 5 x 5 cm) C : The volume of filtered water (25 ml) D: The volume of one drop (0.1 ml) E : Volume of filtered water (5 L) N : The number of periphyton counted

2.5 Water Quality

Water quality measurements in this research included temperature, DO (Dissolved Oxygen) and pH (temperature, DO and pH, respectively, measured with a thermometer, pH meter and DO meter). Water quality data were analyzed descriptively according to the quality standards of Indonesia (Indonesian National Standard).

3. RESULTS AND DISCUSSION

Based on the research activities, the following results are obtained:

3.1 Survival Rate

The results show that survival rate of gorami is in the range of 92-95%. The survival rate of gorami can be seen in Fig. 1.

Based on observations made for 40 days, the highest survival rate of gorami was found in treatment D (30 gorami : 30 nilem) was 95% and the lowest average survival of gorami was found in treatment A (30 gorami: 0 nilem) which was 92%.Other than that the survival rate in this research is above 90%, which is considered quite high. The survival of gorami in polyculture was not significantly differ at the 95% confidence level, this shows that the addition of nilem up to 30 individuals per m2 in the treatment of gorami did not reduce the survival rate of gorami. The polyculture environment did not interfere with the survival of gorami and nilem because the numbers of the both fish were still in the optimal range. The existence of fish deaths that occur during the treatment is allegedly due to stress because of the new envirotment which is floating net cages and polyculture so it caused fish to experience stress.

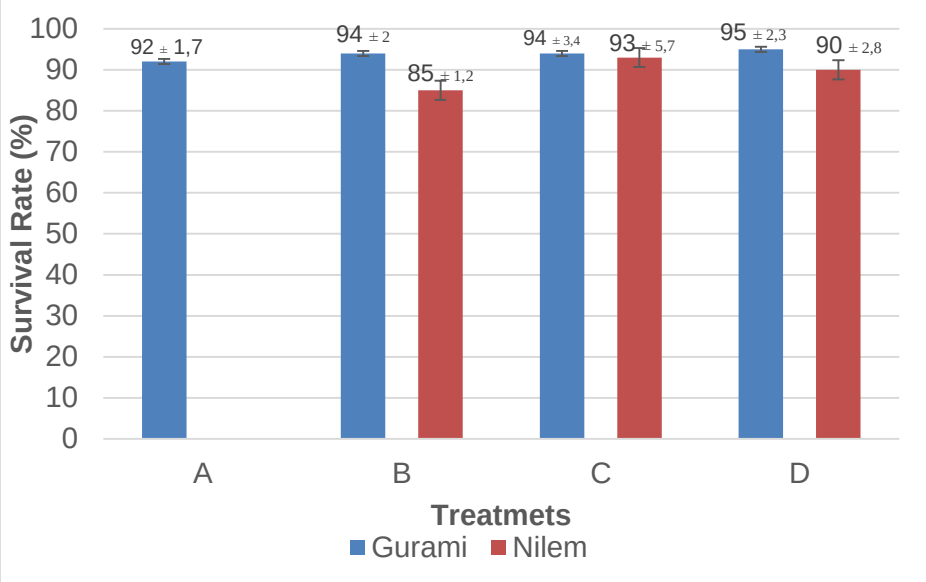

Fig. 1. Survival rate of Gorami and Nilem

According to [8] the survival of gorami (control) was 80% with a stocking density of 10 fish/aquarium. According to [9] the survival of gorami (control) was 100%. According to [10] of 90%, whereas in this study the survival of gorami (control) was 95%. This happens because the quality of water and feed supports survival. Besides, this study uses pond media.

3.2 Specific Growth Rate

The results show that the specific growth rate of gorami is in the range of 0.64 - 1.31%. The specific growth rate of gorami can be seen in Fig. 2.

The specific growth rate in this research shows the varied growth of gorami. The difference in the amount of stocking density in gorami and nilem polyculture gave a response to the growth of the two fish, as evidenced by the increase in the average individual weight in each period. The growth rate of treatment A gorami was 1%, which is a lower value than treatment B and C, when 10 nilem were added (namely treatment B) the growth rate of gorami increased to 1.3%, then nilem was added to 20 (i.e. treatment C) the growth rate of gorami increased to 1.3%, while when nilem was added to 30 individuals (i.e. treatment D) the growth rate of gorami decreased to <1%.

From the four treatments it could be explained that the growth rate of gorami increased by adding nilem up to 20, besides the presence of nilem made gorami more active in consuming feed.The growth rate of gorami was supported by the presence of nilem in the treatment. Treatment A (30 gorami) did not have nilem so that the growth rate of gorami was slower than treatment B (30 goram: 10 nilem) and C (30 gorami: 20 nilem), while in treatment D (30 gorami: 30 nilem) gorami competed with nilem in motion and space. The abundance of periphyton makes the nets dirty, interfering with gorami growth. This is supported by the statement of [11] that the abundance of periphyton makes dirty nets so that it has negative effects on fish growth and according to [12] high stocking density results in lower growth due to competition for space.

3.3 Feeding Efficiency

The results show that the feeding efficiency of gorami is in the range of 0.64 - 1.31%. The feeding efficiency of gorami can be seen in Fig. 3.

The difference in the amount of stocking density of gorami and nilem in each treatment resulted in varying feed efficiency values. The range of feed efficiency values in this research ranged from 26.5 to 32.6%.

Treatments B and C showed a better feeding efficiency value than treatment A, this is presumably because the gorami was more active in consuming feed, besides that nilem also ate periphyton found in floating net cages. Treatment A has a low feed efficiency value when compared to treatment B and C, this is presumably because the nets are dirtier in treatment A.

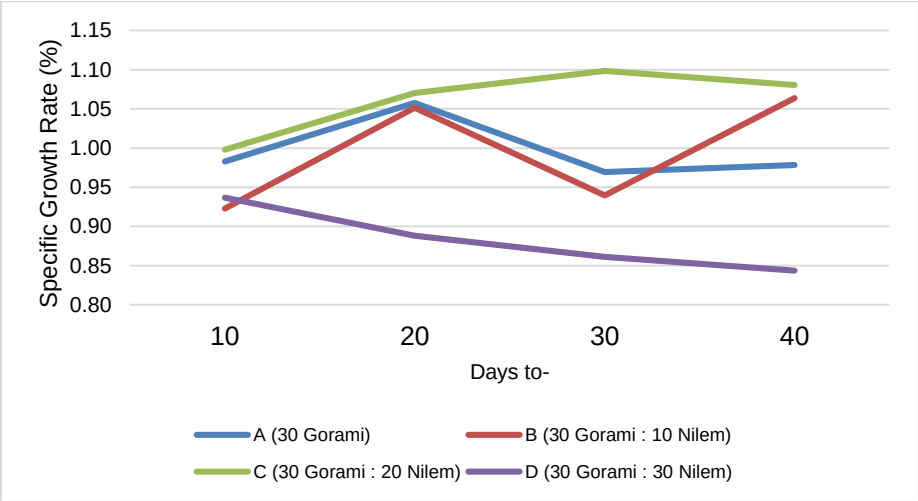

Fig. 2. Specific growth rate of gorami

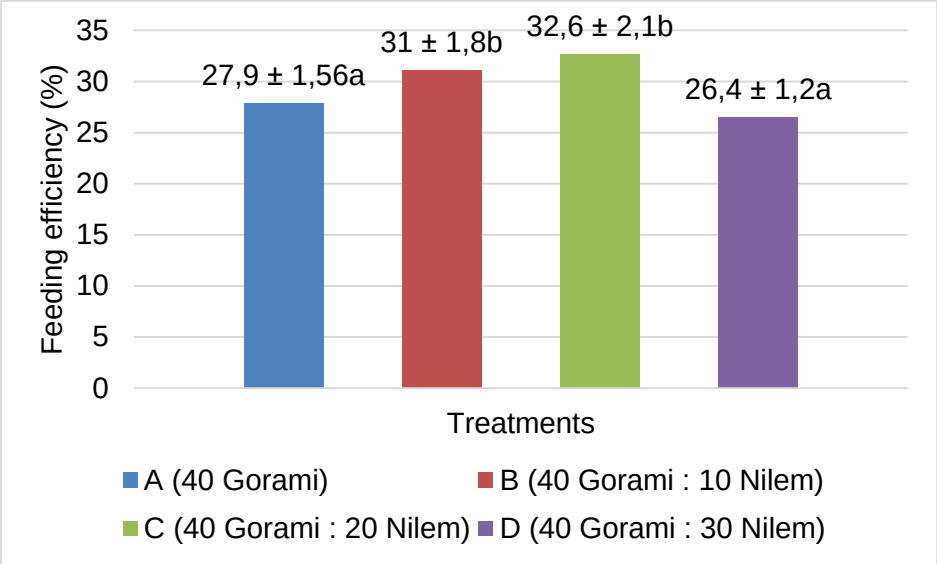

Fig. 3. Specific growth rate of gorami

Treatment D has a lower feed efficiency value when compared to treatments B and C, this is presumably because gorami competes with nilem in movement and space, because the amount of gorami and nilem in treatment D were the same.

Treatment B (30 gorami: 10 nilem) and C (30 gorami: 20 nilem) showed a better feed conversion value than treatment D (30 gorami: 30 nilem) and A (30 gorami), this was due to the fact that feed and the aquatic environment were still support, in addition to the treatment B and C make water circulation more smoothly.

Feed efficiency of gorami in treatment B (30 gorami : 10 nilem) and C (30 gorami: 10 nilem) showed a significant difference compared to treatment A (30 gorami) and D (30 gorami : 30 nilem). The value of gorami feed efficiency increases with increasing growth. According to [13] space for fish will affect feed conversion efficiency and a decrease in feed conversion efficiency in line with the increase in stocking density.

3.4 Periphyton Abundance

Periphyton abundance is calculated based on the calculation of the number of periphyton identified. The data from the calculation of the abundance of periphyton during the study showed the abundance of periphyton data ranging from 4455 to 18787 ind.

The reduction of nilem in the treatment caused the cleanliness of the nets to be visually different, this was because the periphyton and moss were reduced in each treatment, the lower the periphyton, the cleaner the waring in the treatment. The following results of visual waring are presented in Fig. 4.

The reduction in periphyton abundance is directly proportional to the increase in nilem stocking density, this is due to the herbivorous feeding habits of nilem which are able to take advantage of periphyton in waring (Fig. 3). According to [14] it is known that fish in Net / KJA (Keramba Jaring Apung), especially herbivorous fish such as nilem and tilapia, eat a lot of periphyton as their natural feed.

Treatment A (30 gorami) was the treatment that had the highest periphyton abundance, while treatment D (30 gorami: 30 nilem) had the lowest abundance of periphyton. Periphyton abundance decreased along with the increase in the amount of nilem in the treatment, the highest abundance was owned by treatment A (30 gorami) then treatment B (30 gorami: 10 nilem) treatment C (30 gorami: 20 nilem) and the lowest abundance belonged to treatment D (30 gorami : 30 nilem).

3.5 Water Quality

The results of average water quality measurements can be seen in Table 1.

Treatment A (30 Gorami)

Treatment B (30 Gorami: 10 Nilem)

Treatment C (30 Gorami: 20 Nilem)

Treatment D (30 Gorami: 30 Nilem)

Fig. 4. Net visualization

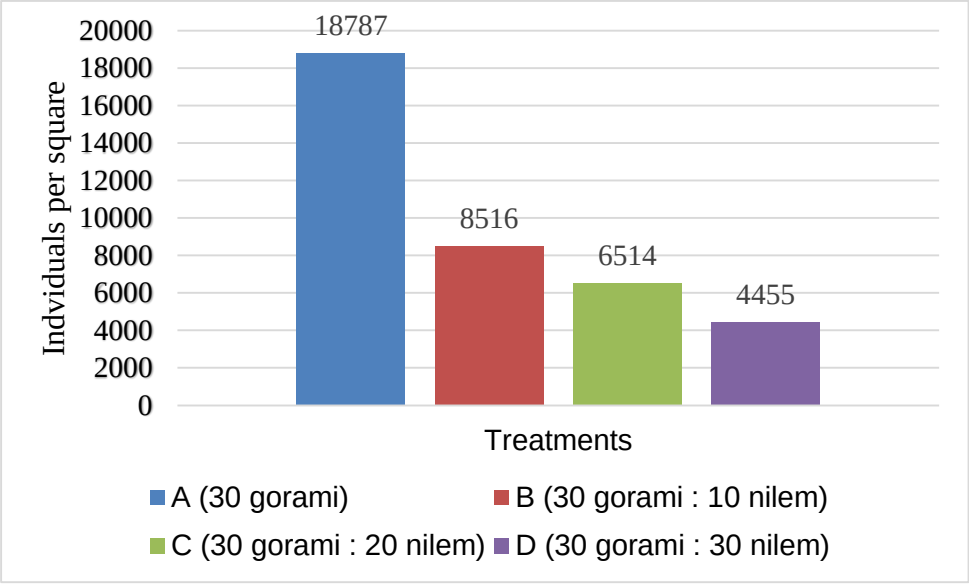

Fig. 5. Periphyton abundance

Table 1. Water quality measurement result

Paremeter	Unit	Range value	Quality standards
Temperature	°C	24-28	25-30*
pH	Mg/L	6.7-7.4	6.5-8.5*
DO	-	3,7-6	>4*

**According to Indonesian National Standard (SNI) 2006 [15]*

The maintenance medium can be measured from the quality of the water, the better the water quality, the optimum growth of the fish.The temperature range obtained was 24-28°C. This temperature range is considered less than ideal for gorami because the temperature range that is good according to the Indonesian National Standard is 25-30°C.Dissolved oxygen (DO) content in the maintenance pond is in the range of 3.7 - 6 ppm.DO range can provide good growth and survival for gorami because the minimum standard of dissolved oxygen according to the Indonesian National Standard is >4 ppm. The degree of acidity (pH) of the water obtained ranged from 6.7 to 7.4. The optimal range of water pH for gorami maintenance ranges from 6.5 - 8.5 (SNI). This shows that the pH of the water is still in normal condition. Overall gorami still within the limits of values that have been determined by Indonesian national standards.

4. CONCLUSION

The results showed that the polyculture system of gorami and nilem, with stocking density of gorami 30 fish/m^2 and 20 fish/m^2 of nilem was the optimal number of stocking densities. The survival of gorami and nilem has a value above 93%. The daily growth rate for gorami and was 1.19%. Gorami feed efficiency of 32.66%.

CONSENT

As per international standard informed and written participant consent has been collectedand preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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